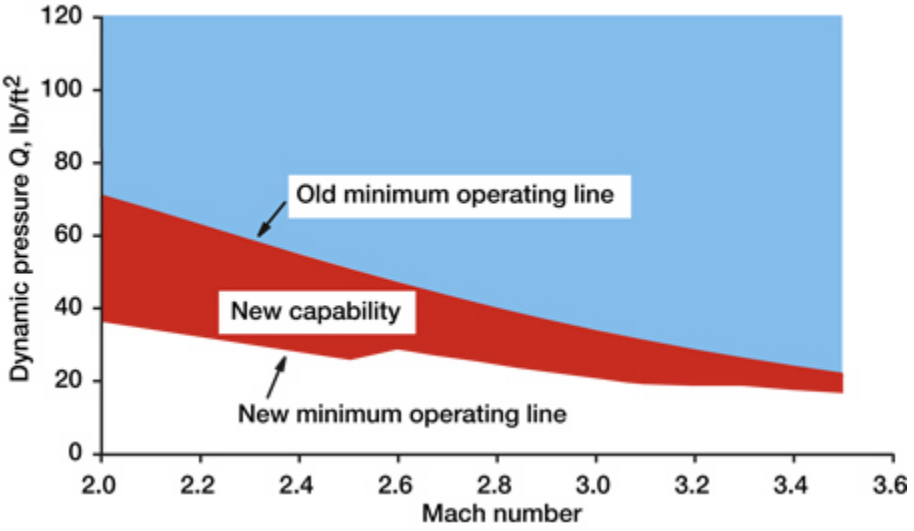
Low-Pressure Capability of NASA Glenn's 10- by 10-Foot Supersonic Wind Tunnel Expanded

Extremely low dynamic pressure *Q* conditions are desired for space-related research including the testing of parachute designs and other decelerator concepts for future vehicles landing on Mars. Therefore, the low-pressure operating capability of the Abe Silverstein 10- by 10-foot Supersonic Wind Tunnel (10×10 SWT) at NASA Glenn Research Center was recently increased. Successful checkout tests performed in the fall of 2002 showed significantly reduced minimum operating pressures in the wind tunnel.



Increase in the minimum dynamic pressure capability in the 10×10 SWT.

Long description. Graph of minimum dynamic pressure *Q* versus Mach number, showing increase of capability between old and new minimum operating lines.

Using Glenn's central exhaust system, set up in a special seven-stage configuration and dedicated to the 10×10 SWT operation, the following test section conditions were run:

Mach number	**Tunnel total pressure, P_t psfa[a]**
2.0 to 2.5	100
3.0 to 3.1	120
3.3	140
3.5	150

[a]Pounds per square foot, absolute.

This essentially reduced the minimum dynamic pressure operating line of the tunnel by about half. At each condition, the various wind tunnel subsystems were checked out--including the drive motors and compressors, coolers, and dew point. New low-pressure transducers installed in the wind tunnel control systems helped to maintain steady test section conditions in this continuous flow facility.

In addition to successfully validating tunnel operations, we measured some test section conditions to determine if there were any flow quality issues at the extreme low pressures. This was not the case since the test section boundary layer was determined to be about 1 ft thick, essentially the same as at higher tunnel pressures; and the cross-sectional total temperature distribution in the test section appeared to be uniform.

A modified test section "calibration wedge" was also validated during this test. This tool is used to calibrate test section conditions--pressure, temperature, Mach number, and flow angle. Prior to this test, we determined that existing wedges could not be used at these low pressures (because of orifice size, line size, etc.). One wedge was modified and installed in the test section, and successful pressure measurements were obtained. This modified wedge design will be used for a future planned low-pressure calibration of the test section. Expanding the low-pressure capability of the 10×10 SWT will enhance its usefulness in furthering this Nation's space endeavors.

Find out more about this research at http://facilities.grc.nasa.gov/

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